NUMBERS, DISTRIBUTION, AND PRODUCTIVITY OF CARIBOU IN NORTHEASTERN KEEWATIN DISTRICT NORTHWEST TERRITORIES

by
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ABSTRACT

The purpose of this study was to determine the numbers, distribution and calf production, of caribou in two previously unstudied areas of Northeastern Keewatin District, Northwest Territories. Aerial surveys were conducted north of Chesterfield Inlet between 15 and 25 June, 1976 and north of Wager Bay between 29 June and 2 July, 1976.

The caribou found north of Chesterfield Inlet (the Lorillard herd) were considered to be a social unit because they used a distinct calving ground. The observed calf to cow ratio in this area was 60 calves to 100 cows, and the total population of caribou over one year of age was estimated to be 13,780 ±3,357 (SE). We could not distinguish a distinct calving ground north of Wager Bay (the Wager Bay herd) since the cows and calves had moved to join the bull segment of the population by the time these surveys were flown. The observed calf to cow ratio north of Wager Bay was 58 calves to 100 cows and the total population of caribou over one year of age was estimated to be 9,369 ±1,064 (SE).

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ACKNOWLEDGEMENTS

We would like to thank Douglas Stewart, the Wildlife Officer in aker Lake, and our pilot Mark Crossman, both of whom contributed greatly o the success of this project.

INTRODUCTION

Information on the caribou occupying the vast areas north of Chesterfield nlet and Wager Bay was virtually non-existent at the beginning of this study. e region with which we were concerned is approximately 50,000 mi^2 in size. The jectives of these surveys were to determine the numbers, distribution, and productivity of the caribou in these regions through the use of aerial census techniques. is information is necessary before more detailed analysis of the impact of gas pipene construction through this region could begin.

METHODS

We divided the area to be surveyed into two units: (1) Lorillard study area (Fig. 1), surveyed 15 - 25 June, 1976, and (2) The Wager Bay study area (Fig. 2), surveyed 29 June to 2 July, 1976. The Lorillard study area occupied about 25,000 mi.^{2} It was delimited by Chesterfield Inlet, Hudson Bay, Wager Bay, 66° 00' north latitude, and 94° 00' west longitude. Twenty-one north-south transect lines were established at 10 mile intervals over this area (Fig. 1).

The Wager Bay study area occupied approximately 22,000 mi.^{2} bounded by the Gulf of Boothia, the Franklin-Keewatin border, Hudson Bay, Wager Bay, 97° 00' west longitude, and the Arrowsmith River (Fig. 2). On June 29 we made a reconnaissance flight to determine general caribou density and distribution. We divided the area into four strata based on this cursory evaluation of caribou density. Stratum #1 had the lowest caribou density and received 5% coverage from 16 transects, 7 transect lines were established over stratum #2 and 8 over stratum #3, to give 10 and 20% coverage respectively. We attempted to count all of the caribou in stratum #4 because of the dense aggregations of caribou and rugged topography in this region. In the other strata, transect lines were spaced at 5, 10, and 20 mile intervals to obtain the desired coverage (Fig. 3). Two additional strata were distinguished after the survey. Stratum #1a was treated as a distinct unit because no caribou were seen in this area. Stratum #1c was omitted from the analysis in an attempt to avoid overlap between this survey and the Melville Peninsula survey (Calef and Helmer 1977).

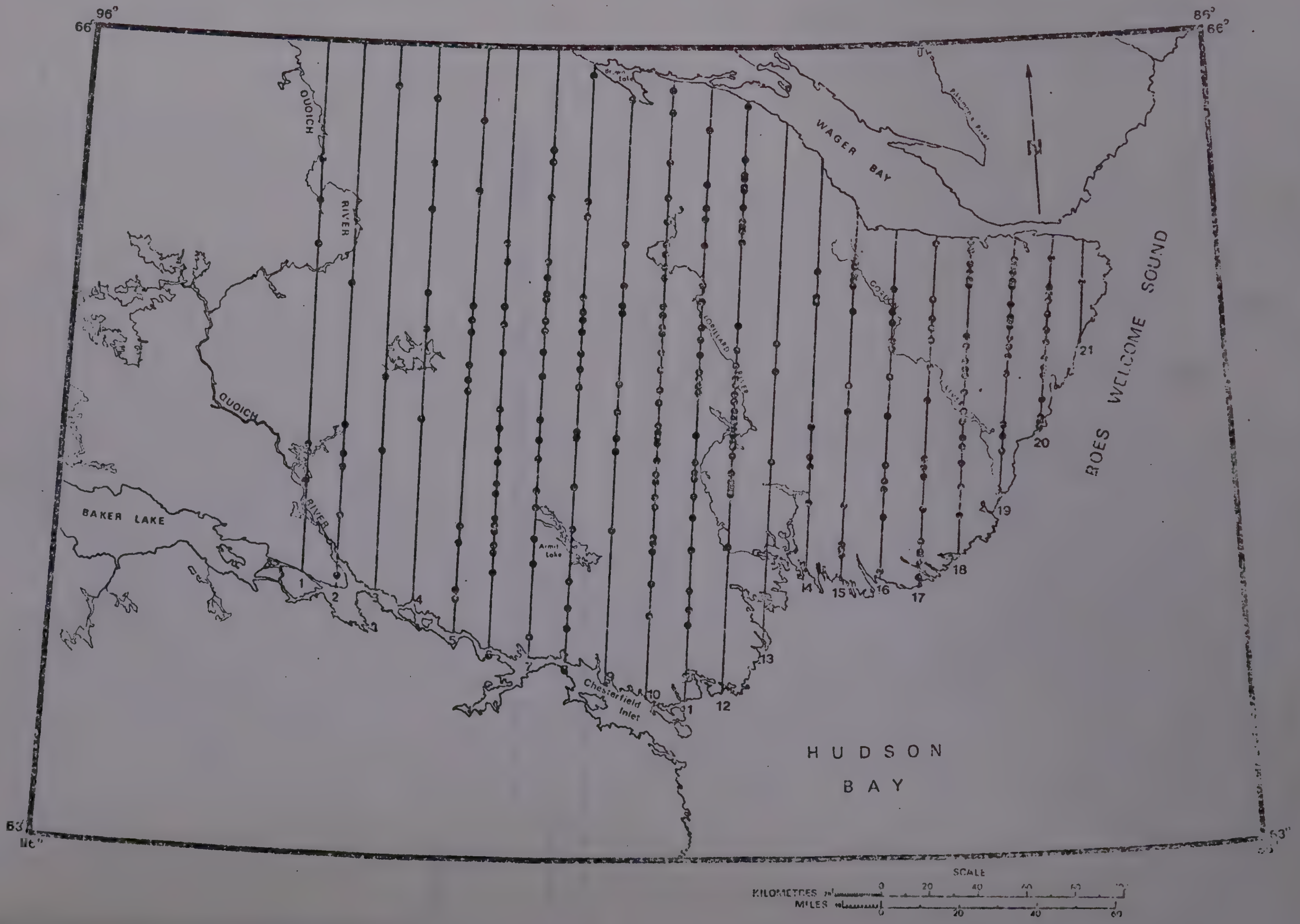
In both the Lorillard and Wager Bay study areas transect lines were flown at an elevation of 400 ft. at 120 mph in either a Cessna 185 aircraft

(15 - 25 June) or a Cessna 337 aircraft (23 June - 2 July). Each of two observers counted all of the caribou within one-half mile from the side of the plane on which he was sitting and classified them as cows, calves, bulls or unknowns. Calves were easily recognizable by their small size and bulls were distinguished by the presence of antlers. All non-bull caribou in groups containing calves were considered to be cows. The pilot navigated and plotted the location of each sighting on 1:250,000 scale topographical maps while the observers recorded the corresponding data on tape, thus never having to look away from the transect strip.

Systematic sampling distributes samples more evenly over the population than does random sampling. For this reason systematic sampling will give more accurate results of distribution and production (calf to cow ratios) than will simple random sampling. One disadvantage of systematic sampling is that, unlike random sampling, there is no reliable method for estimating the standard error of the sample mean, or in this case the population size (Snedecor and Cochran 1971:519). However, we decided to use systematic rather than random sampling and to calculate the standard errors as if the data were collected from random samples. Although there are some theoretical objections to standard errors calculated using this method, the resulting standard errors probably approximate the true error even, though they cannot be used as a test of significance between samples (Bergerud, 1963). Population estimates and standard errors were calculated using Jolly's Method 2 for unequal sized sampling units (Jolly 1969) and Norton-Griffiths' method for integrating the results from different strata (Norton-Griffiths 1975).

FIGURE 1.

Map of the Lorillard study area showing the location of the 21 transect lines and the caribou sightings. Dots indicate the positions of sightings of one or more groups of caribou.


96°
66°
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63°
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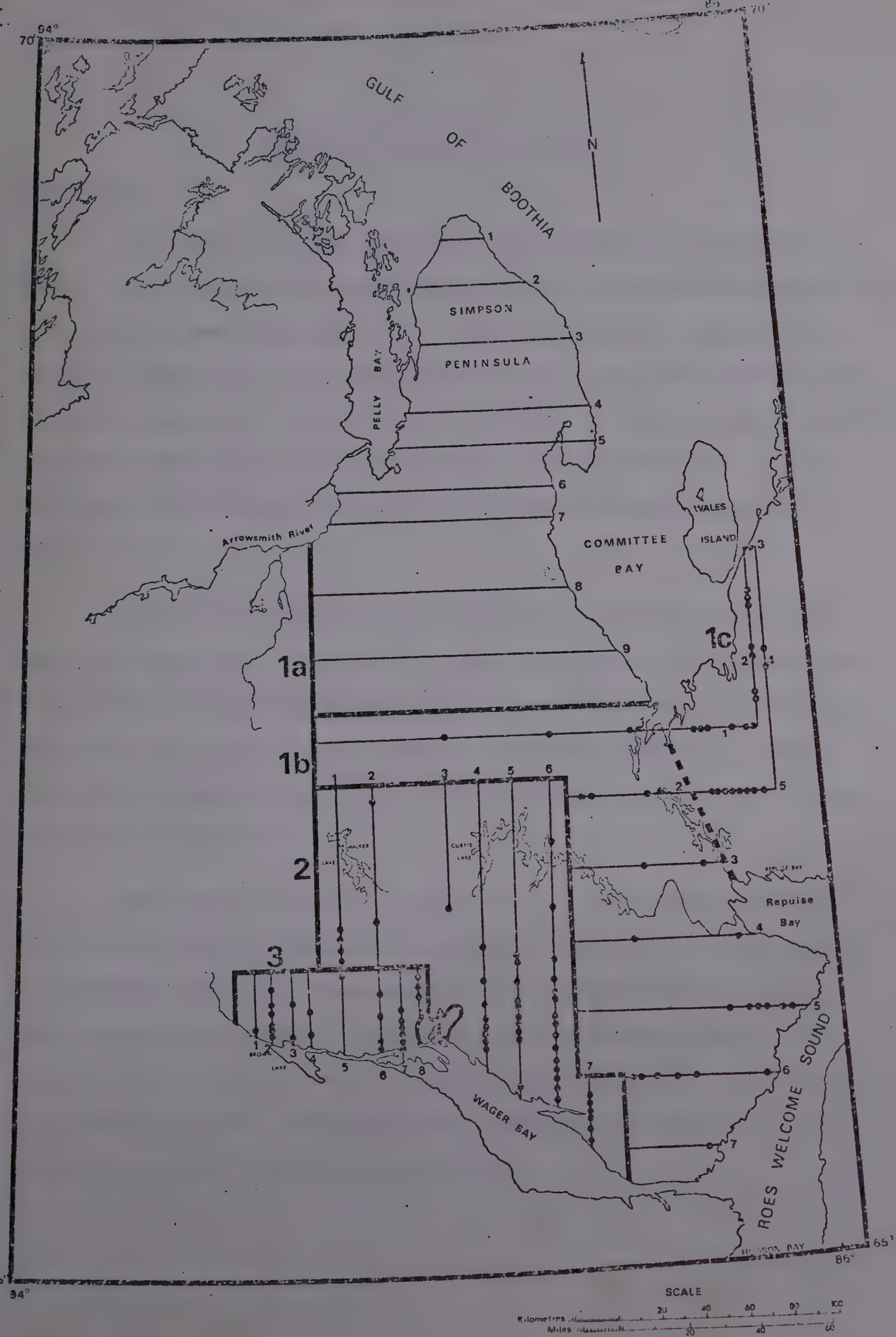
63°
QUOICH
RIVER
BAKER LAKE
Armit Lake
Chesterfield Inlet
LORILLARD RIVER
WAGER BAY
BOES WELCOME SOUND
HUDSON BAY
N
1
2
4
10
11
12
13
14
15
16
17
18
19
20
21
SCALE
KILOMETRES
0
20
40
60
MILES
0
20
40
60

Figure 2.

Map of the Wager Bay study area showing the strata, transect lines and the caribou sightings. Dots indicate the positions of sightings of one or more groups of caribou.


94°
70°
86°
70°
GULF OF BOOTHIA
N
SIMPSON PENINSULA
PELLY BAY
Arrowsmith River
WALES ISLAND
COMMITTEE BAY
1a
1b
1c
2
3
1
2
3
4
5
6
7
8
9
WALKER LAKE
CURTIS LAKE
BROWN LAKE
REPULSE BAY
Repulse Bay
WAGER BAY
ROES WELCOME SOUND
HUDSON BAY
65°
86°
65°
94°
SCALE
Kilometres
20
40
60
80
100
Miles
20
40
60

RESULTS OF THE LORILLARD SURVEY

Distribution

The number of caribou observed on each transect is presented in Table I. Bull caribou were sharply separated from the area in which most of the cows and calves were located (Fig. 3). Cows and calves were concentrated on the high plateau south of Wager Bay, although a few calves were observed over the entire study area. From the data, we delimited a calving ground of 4700 $mi.^2$ within which 88% (326/370) of the calves were observed (Table II). Bulls, yearlings, and non-productive cows occupied areas off the calving ground (Fig. 2 and Table II).

The calving ground differed in physical characteristics from the rest of the study area. It occupied a high rocky plateau (elevation from 800 to 1,600 ft.). The calving ground appeared to be cooler than the lower areas since newly fallen snow persisted longer at the higher elevations. These characteristics appear to typify the calving grounds of most Canadian mainland caribou (Parker 1972:27).

The density of caribou was much higher on the calving ground than it was off the calving ground, 2.13 $caribou/mi.^2$ (1009/473) vs. 0.36 caribou/$mi.^2$ (739/2065, Table II). Cows comprised 80.2% (548/683) of the caribou over one year of age that were found on the calving ground (Table II). The group size on the calving ground, including calves averaged 7.9 ± 1.3 (683/87, with a range of 1-100). It was necessary to estimate the group size in two groups that were too large to count accurately.

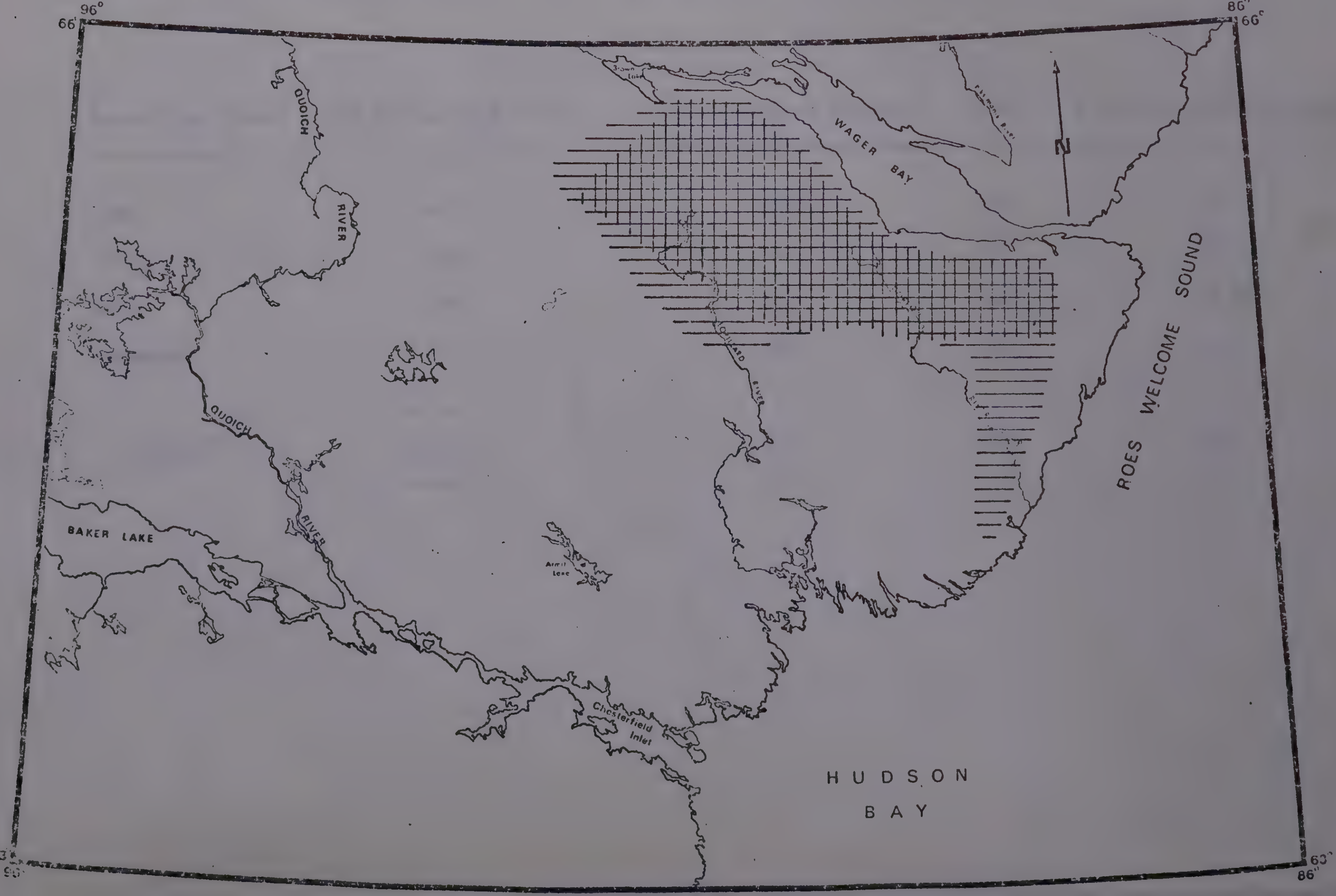
TABLE I. Numbers of caribou observed per transect on the Lorillard study area.

Transect Number	Transect Area (z) (mi.^{2}) *1	Cows	Calves	Bulls	Unknown	Total	Total Caribou Over One Year of Age	Density of Caribou Over One Year of Age
1	143.8	4	4	1	8	17	13	.09
2	140.5	1	1		6	8	7	.05
3	141.7	7	7		1	15	8	.06
4	142.8				23	23	23	.16
5	151.1	5	1		43	49	48	.32
6	154.5	10	5		96	111	106	.69
7	149.7	3	2		37	42	40	.27
8	156.1	25	13	11	19	68	55	.35
9	153.6	17	8	12	12	49	41	.27
10	159.8	25	12	19	34	90	78	.49
11	159.5	109	78	41	60	288	210	1.32
12	153.6	64	49	36	55	204	155	1.01
13	140.5			1	1	2	2	.01
14	107.7	53	32	5	12	102	70	.65
15	96.7	21	8	8	15	52	44	.46
16	91.9	3		9	35	47	47	.51
17	90.6	9	5	16	12	42	37	.41
18	83.3	256	122	11	41	430	308	3.70
19	44.9	40	22		13	75	53	1.18
20	50.9	3	1	12	15	31	30	.59
21	25.0				3	3	3	.12
Totals	2,538.2	655	370	182	541	1,748	1,378	.54

*1 transect width was 1 mile therefore transect area = transect length

Figure 3.

Map of the Lorillard study area showing the distribution of bull caribou and the calving ground.


96°
66°
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66°
63°
96°
63°
86°
QUOICH
RIVER
QUOICH
RIVER
BAKER LAKE
Armit Lake
Chesterfield Inlet
Brown Lake
WAGER BAY
N
LORILLARD
RIVER
ROES WELCOME SOUND
HUDSON
BAY

TABLE II. The proportion of caribou in each age and sex class on and off the Lorillard calving ground.

Age or Sex Class	On the Calving Ground	Off the Calving Ground	Total	% on the Calving Ground
Cows	548	107	655	84
Calves	326	44	370	88
Bulls	36	146	182	20
Unknowns	99	442	541	18
TOTALS	1,009	739	1,748	58

Productivity

The calf to cow ratio based on data from the whole study area, using only those groups containing calves, was 60 calves to 200 cows (370:621). The calf-cow ratio was significantly higher at the centre of the calving ground 67 calves: 100 cows (272:406, Fig. 2) than over the rest of the study area where it was 46 calves: 100 cows (98:215, $X^2 = 7.21$, p 0.01, df = 1). This relationship did not change when the two large (estimated) groups were dropped from the analysis.

The ratio of calves to adult females provides the most accurate index of production and calf mortality. Unfortunately, unless the number of yearlings in groups that contain calves is equal to the number of non-parous adult females that are not in groups containing calves, the calf - cow ratio expressed here is somewhat biased. Since it is not possible to distinguish between these two groups of caribou during aerial surveys, no indication of the magnitude or direction of this bias can be obtained. The most frequently used method for expressing calf production and survival in caribou populations is the percentage of calves in the total population. In the Lorillard study area, calves made up 21.2% (2700/17,480) of the total population.

Population Estimates

By multiplying the numbers of caribou/mi.^2 as determined from the aerial survey by the total number of square miles in the study area, the population of caribou (excluding calves) was estimated to be 13,780 ±3,357 (Table III). As a result of the high variance in the number of caribou observed per transect (e.g. transects 11, 13, 18, Table I), ninety-five percent confidence limits were very high, 50.8% of the total.

TABLE III. Calculations of population size and variance for both the Lorillard and Wager Bay caribou populations after Jolly (1969) and Norton-Griffiths (1975).

Area Surveyed	Number of Transects Surveyed (n) *1	Total Number of Transects Possible (N) *1	Total Area (Z) (mi.^{2})	Density of Caribou (R)*2 per mi.^{2}	Pop. Est. (y) *3 (Caribou over one year of age)	Pop. Variance (VAR (y))*4	St. Error (SE) of the Population *5	95% CL's on the Pop. Est. *6
Lorillard herd whole area	21	210	25,382	0.548	13,780	11,269,125	3,357	50.8
calving ground only	13	-	4,730	1.444	6,830	-	-	-
Wager Bay Strat 1a	9	-	7,447	0.0	0	-	-	-
" 1b	7	140	7,707	0.308	2,374	414,736	644	66
" 1c	5	-	-	-	-	-	-	-
" 2	7	74	5,811	0.680	3,952	313,494	560	35
" 3	8	51	1,123	1.655	1,858	402,944	635	81
" 4	-	-	70	16,929	1,185	0	0	0
Wager Bay Total	-	-	22,158	-	9,369	1,131,174	1,064	23.6

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*1 N is the total number of transects possible that can be established over the area from which a sample of n of these are selected and surveyed.

*2 $R = \Sigma y / \Sigma z$ total animals counted/the total area searched (from Tables I and IV as appropriate).

*3 $Y = R.Z$

*4 $VAR\ (y) = ((N)\ (N - n)/n)\ ((S^2 y) - (2)\ (R)\ Szy + (R)^2\ (S^2\ z))$

Another semi-independent estimate of population size can be obtained by extrapolating the data from the calving ground. The population estimate for caribou over one year of age on the calving ground was 6,830 (Table III). If the Lorillard River is distributed in the same way as the Kaminuriak caribou herd, then 80% of the caribou over one year of age that were on the calving ground should be breeding females, and these breeding females should comprise 43% of the total population (Parker 1972:86-87). As was previously mentioned, adult females made up 80.2% of the non-calf segment of the population on the Lorillard calving ground. Thus there is support for assuming that the same distribution occurs in Lorillard herd as in the Kaminuriak herd. Therefore, the total population of caribou over one year of age can be estimated by dividing the number of adult females on the calving ground by 0.43, yielding 12,744 animals (5480/0.43). The good agreement between these two methods of estimating the population suggest that our estimates are accurate despite the broad confidence intervals.

RESULTS OF THE WAGER BAY SURVEY

Distribution

The number of caribou observed on each transect is presented in Table IV. The distribution of bulls and cows with calves overlapped more in the Wager Bay study area than in the Lorillard study area. Calves in the Wager Bay herd were distributed over the entire area surveyed (Fig. 4 and 5). Ninety-five percent of the bull caribou were within ten miles of the coast (Fig. 5). The observed distribution of bulls was not biased by transect orientation because the transects were perpendicular to the coast (Fig. 2). The highest density of calves occurred in stratum 4 (Table V), but the total number of calves estimated to be in each stratum was quite similar; stratum 1b - 565 calves, stratum 2 -

744 calves, stratum 3 - 455 calves and stratum 4 - 488 calves. Like the calves, the highest density of bulls was observed in stratum 4. The density of both adult and calf caribou varied with the strat in the order predicted from the preliminary survey (Table V).

The average group size (including calves) in strata 1b, 2, and 3 was 7.8 ± 1.4 caribou (Table VI). The density of caribou was so high in stratum 4 that it would be meaningless to try to distinguish individual groups even though some clumping did occur.

The large post-calving concentrations of caribou in stratum 4 were moving south down the river valleys toward the coast of Wager Bay. Their direction of movement indicated that they had calved further north, presumably on the rocky plains south of Curtis Lake (Fig. 4). It is unlikely that the caribou had moved further than this because calving had only occurred about two weeks earlier. Cows and calves that were observed in the other strata could also have come from a Curtis Lake calving ground. Alternatively, caribou in the Wager Bay study area could have given birth while in medium sized groups distributed throughout the study area.

Bulls in the Kaminuriak herd are distributed around the coastal plain in early summer as are the bulls in the Wager Bay herd; however, the mixing of bulls and post-calving groups of Kaminuriak caribou do not usually form until later in the summer (Parker 1972). The mixing of bulls and post-calving groups in the Wager Bay area so soon after calving is probably a result of the calving area being close to the coast rather than the existence of social organization different from that of the Kaminuriak herd.

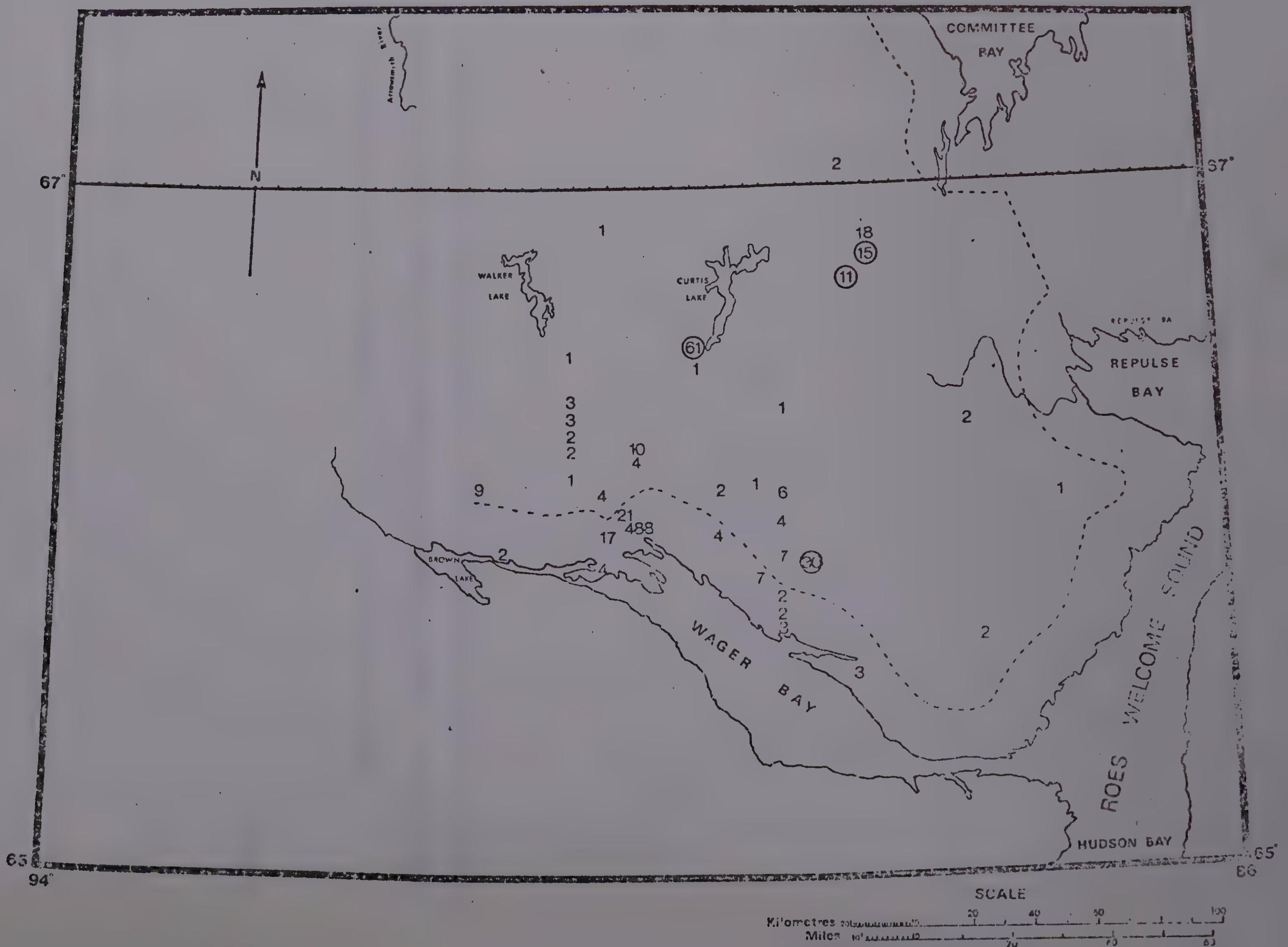
Table IV. Numbers of caribou observed per strat and per transect on the Wager Bay study area.

Stratum	Transect Number	Transect Area (mi.^{2}) (z)*1	Cows	Calves	Bulls	Unknowns	Total	Total Caribou over 1 year of age	Density of Caribou over 1 year of age
1a	1 to 9	-	0	0	0	0	0	0	0
1b	1	98.6	4	2	2	9	17	15	.15
	2	24.7	28	18		6	52	34	1.38
	3	48.4			1	5	6	6	.12
	4	38.1	2	2		10	14	12	.32
	5	57.8	6	1	5	5	17	16	.28
	6	44.7	3	2	1	17	23	21	.47
	7	28.5	-	-	1	-	1	1	.04
Totals		340.8	43	25	10	52	130	105	.31
1c	1	23.4			1	25	26	26	1.11
	2	41.7	16	8	4	29	57	49	1.18
	3	4.7				5	5	5	1.06
	4	41.7	12	10		1	23	13	.31
	5	25.8				79	70	70	2.71
Totals		137.3	28	18	5	130	181	163	1.19
2	1	52.3	18	11		2	31	20	.38
	2	52.3	7	1		3	11	10	.19
	3	82.3	19	6	29	19	73	67	.81
	4	34.4	4	1			5	4	.12
	5	90.9	15	8	24	25	72	64	.70
	6	95.3	51	25$^+$	10	19	105	80	.84
	7	21.9	12	3$^+$	10	25	50	47	2.15
Totals		429.4	126	55	73	93	347	292	.68
3	1	20.5				6	6	6	.29
	2	21.6	10	9	12	8	39	30	1.39
	3	21.9	4	2	5		11	9	.41
	4	22.7				14	14	14	.62
	5	23.8	1	1			2	1	.04
	6	25.0	45	25	4		74	49	1.96
	7	26.6	32	21	9	64	126	105	3.95
	8	15.6	25	14		55	94	80	5.13
Totals		177.7	117	72	30	147	366	294	1.65
4	Survey	-	921	104*2	75	189	1,289	1,185	16.93
	Initial Recon.		976	445	84	321	1,826	1,381	19.73

*1 See Table I
*2 Artifically low see text for explanation

Figure 4.

Map of the Wager Bay study area showing the distribution of caribou calves. Numbers indicate the location of sightings and the number of calves seen. The circled numbers represent the location and numbers of calves observed off transect lines. The dashed line is 10 miles inland from the coast.


COMMITTEE BAY
Arrowsmith River
N
67°
67°
WALKER LAKE
CURTIS LAKE
REPULSE BAY
BROWN LAKE
WAGER BAY
ROES WELCOME SOUND
HUDSON BAY
65°
94°
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SCALE
Kilometres
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488
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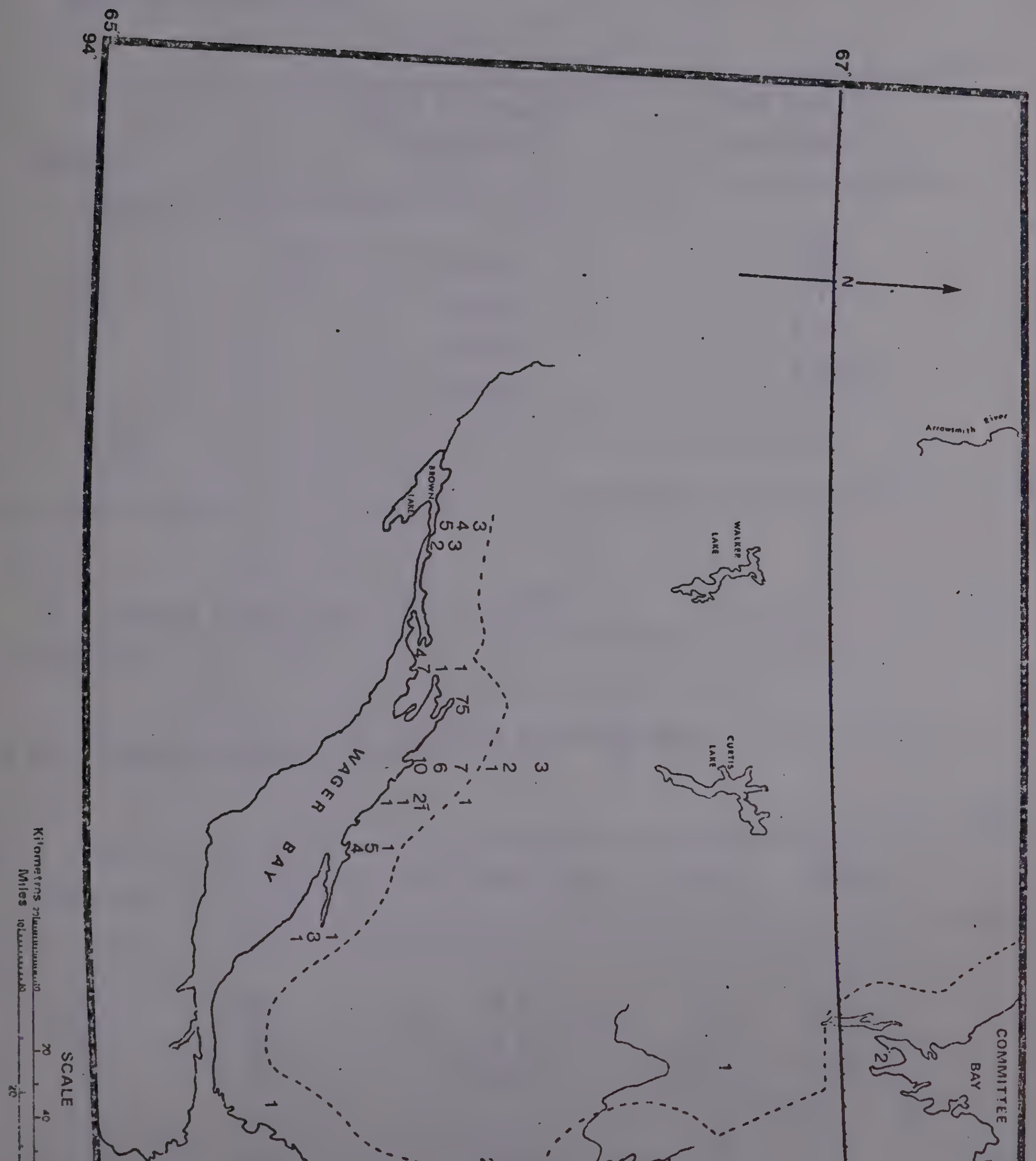
FIGURE 5.

Map of the Wager Bay study area showing the distribution of bull caribou. Numbers indicate the location and group size of all bull caribou observed. The dashed line is 10 miles inland from the coast.


65°
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COMMITTEE BAY
REPULSE BAY
REPULSE BAY
ROES WELCOME SOUND
HUDSON BAY
SCALE
Kilometres
Miles
67°
86°
65°

TABLE V. The density of adult and calf caribou in each stratum of the Wager Bay caribou survey.

Stratum	Adult Density (R) (caribou/mi^2)	Calf Density (caribou/mi^2)
1b	0.31	0.07
2	0.68	0.13
3	1.65	0.41
4	16.93	6.97*1

*1 assuming a calf:cow ration of 53:100

TABLE VI. Average group size in the Wager Bay study area.

Stratum	No. of Groups	Mean Group Size	S.E.	Range
1b	25	5.2	1.8	1-46
2	53	6.5	0.7	1-23
3	31	11.8	2.0	1-48
AVE	109	7.8	1.4	-

ductivity

The calf to cow ratio was 58 calves to 100 cows (Table VII). In culating the data for Table VII, two groups in which the calves were not nted accurately were omitted from both strata 2 and 3. In stratum 4 our ort was concentrated on obtaining accurate counts of adults, thus the total ber of calves counted in this area was low (Table IV). In most groups only adults were counted accurately while the number of calves was estimated. result was an underestimate of the calf-cow ratio, since the groups in ch the calves were accurately counted probably were biased toward those h fewer (therefore easily counted) calves. If data from only strata 1b, 2, 3 are used to calculate the calf-cow ratio, the result is 60 calves:100 s. Calves made up 19.4% (2,252/3,369) of the total population.

ulation Estimates

The total number of caribou over one year of age was estimated to be 69 ±1,064. The total number of caribou in the Wager Bay herd was estimated be in each stratum. The number in each of strata 1b, 2, and 3 were estimated multiplying the average density in each stratum by the area of the stratum ble III). A total count was achieved in stratum 4. Approximately one half these animals were located in stratum 2, while no caribou were observed in atum 1a (Table IV). Ninety-five percent confidence limits on the population imate were 23.6%. The error on the sampled population (Strata 1b, 2, and 3) 27.0%, but this value is only of interest with respect to determining the iciency of the sampling techniques. For management purposes it is the error ociated with the estimate of the toal population that is required.

TABLE VII. Calf to cow ratios in the Wager Bay study area.

Stratum	Number of Cows	Number of Calves	Calves per 100 Cows
1b	25	43	58
2	50*1	100	50
3	64*1	90	71
4	44*1	83	53
Total	183	316	58

*1 estimated group sizes omitted from the analysis.

When complete counts are undertaken in counting animals, sampling error is zero. However, there is still likely to be some error in the form of observer bias. It is possible that the results of the counts obtained form stratum 4 are biased by the numbers of caribou in the large groups being estimated incorrectly, and by some groups being missed while others were counted more than once. A check on these potential biases can be obtained since we attempted to count all the animals in stratum 4 on our initial reconnaissance flight. The close similarity between these two results (Table IV) was quite encouraging. It would have been unreasonable to assume that the results would be indentical because 1) many caribou could have moved in or out of the area in the two days between these surveys and 2) the boundaries, although similar, were not identical on both days. The similarities between these results suggested that sampling biases were unlikely to be very great as a result of overcounting or missing large numbers of caribou. Biases in the estimation of group size would not show up in this comparison if we were consistent between days.

DISCUSSION

The use of a distinct calving ground that is avoided by bulls, yearlings, and non-productive cows is typical of most caribou herds (Parker 1972, Kelsall 1968). Caribou in the Lorillard herd conformed to this pattern but the presence of a distinct calving ground was not so clearly demonstrated by the data from the Wager Bay Study area. Although there was a large amount of overlap between bulls,and cows and calves, on the coast of Wager Bay, it

appeared that the cows and calves had just arrived there, from calving grounds to the north of the bull concentration. Cows may or may not have been concentrated on a calving ground when they gave birth.

The calf to cow ratio of 58 to 60 calves:100 cows, that were obtained in the Wager Bay herd and the Lorillard herd respectively, were only slightly lower than the ratio of 69:100 observed among the Kaminuriak caribou (Parker 1972:71, 60:100), and similar to the Melville Peninsula herd (Calef and Helmer 1977; 62:100) and the Nelchina herd (Sloog 1968; 60:100, average from 1955 to 1962). The higher calf-cow ratio found on the centre of the Lorillard calving ground may indicate that there is a higher survival of calves in this area, and therefore a selective advantage giving birth there. Increased survival could be a function of a reduced wolf predation at higher densities (Holling 1959) and/or some favourable physical/climatic attribute of the habitat that reduced density independent mortality (Parker 1972:27). It is also possible that calf survival is independent of the area where they are born and calf-cow ratios were biased by our smapling methods. If, on the edges of the calving ground, there were a high proportion of non-porductive cows mixed in with the parous females relative to the centre of the calving ground, we would have obtained the same results. Ground surveys would be required to distinguish between these two explanations.

Parker (1972) found that calves made up 30.0% of the total population just after calving, in mid-June, and that by mid-July, calves had declines to 14.7% of the total population. The percentages of calves in the total population of caribou in the Lorillard and Wager Bay herds were lower (21 and 19%, respectively) than the proportion on the Kaminuriak calving ground (30%; Parker

1972). This, coupled with the lower calf-cow ratios indicates that these areas did in fact have a lower production of caribou than the Kaminuriak population did in 1968. Since the survey of the Wager Bay herd was done about 2 weeks after calving was assumed to have occurred, the low production measured may be partly a result of the high mortality which apparently occurs during this period (Parker 1972).

The population estimate obtained from extrapolating the census of the Lorillard calving ground was very similar to the estimate obtained using the data from the entire area surveyed. This result suggests that the herd associated with this calving ground was distributed within the surveyed area. The similarity of the two population estimates also indicates that a population estimate of approximately 13,000 caribou is more precise ~~accurate~~ than the standard error (50.8%) that was calculated from only one set of data would suggest.

The population estimates obtained in this study are probably low, the degree to which they are biased depending on how many caribou we failed to observe on the transect strips. Other authors suggest that observers usually miss about 20% of the caribou (Parker 1972, Thomas 1969). If our biases were similar to theirs, the increased population estimates would be 17,225 (1.25 x 13,780) and 11,711 (1.25 x 9,369) caribou for the Lorillard and Wager Bay populations respectively.

The population estimate for the Wager Bay herd was within the precision ~~accuracy~~ range normally obtained in surveys of large mammals (95% confidence limits: Calef and Helmer 1977, 16%; Sinclair 1972, mean from 7 surveys 21%, range 11 - 40%; Evans et al 1966, mean from three surveys 30%, range 25 -38: Siniff and Skoog 1964, 22%).

The error associated with the Lorillard population estimate was very high. This error could be reduced in future surveys without any increase in cost (flying time), if the study area were fist divided into 2 (or more) strata. The most obvious method of stratification would be to distinguish two strata, one on, and one off the calving ground. If these two strata had been recognized at the outset of this survey the 95% confidence limits would have been reduced from 50.8% to 36.3% of the population size. Error could also be reduced by optimizing the sample size in each of these stratas (Snedecor and Cochran 1967:523). The optimal allocation of sampling intensity would be to fly 12 transects off the calving ground and 39 transects over the calving ground. If this had been done the 95% confedence limits would have been only 28.9% of the population size. Thus stratification and optimization of sampling intensity would reduce the 95% confidence limits from 50.8% to 28.9% with the same amount of flying time! However, both of these modifications required information that was obtained as a result of this study and was therefore unavailable at the outset.

Without stratifying the study area, error could only be reduced by increasing the sampling intensity over the whole area. Fifty-four transects would have to be flown to reduce the 95% confidence limits to 28.9%. This is a 2.6 times the number of transects actually flown.

The optimal sampling intensity for the Wager Bay survey was almost the same as what we did use. We flew 7 transects in strata 1b and 2, and 8 transects in strata 3. The optimal sampling intensity for the same amount of flying time was 7 transects in strata 1b, 6 in strata 2, and 12 in strata 3.

Optimal sampling here would only have reduced the 95% confidence limits from 23.6% to 22.4% of the population size.

The approximately 25,000 caribou estimated to range on the two study areas described here, substantially increase the number of caribou known to exist in Northeastern Keewatin. The two caribou groups described here appear to be distinct herds in that they calve on separate and distinct calving areas. They also appear to be distinct from the Melville herd to the north (Calef and Helmer 1977) and from the Kaminuriak herd to the south (Parker 1972; Calef and Hawkins 1977).

The data presented here, and those of Calef and Helmer (1977) are the first to provide information on the density of caribou living year round north of tree line on the mainland.

It is impossible to say whether more or fewer caribou have previously inhabited the areas described here since no previous surveys had been done in these areas. It is interesting to note however that in recent years the Kaminuriak herd has probably declined by approximately 20,000 animals (Calef and Hawkins 1977). It is possible that some of the caribou in the Lorillard herd are emigrants form the Kaminuriak herd. However, the existence of a calving ground separate from the Kaminuriak suggests that these animals must currently be considered as a population separate from the Kanimuriak herd.

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